Crater-lake flooding as indicator for paleoclimate conditions on Mars

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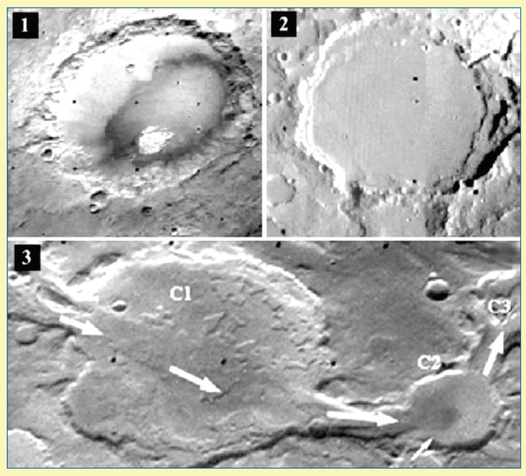
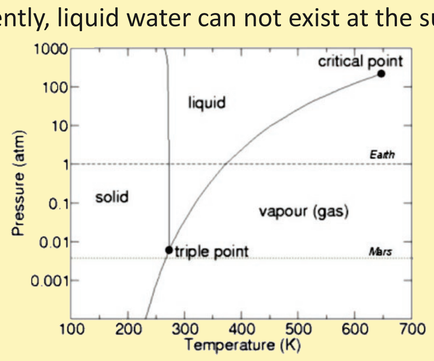
Background

Crater-lake flooding

Many morphologies indicate fluid water on Mars. Flooding of paleolakes is thought to be a very important process in the development of Martian surface channels.



Currently, liquid water can not exist at the surface

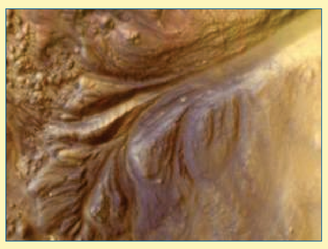


Possible causes climate change

- Changes obliquity
- Volatile cycling
- Volcanism
- Crater impacts

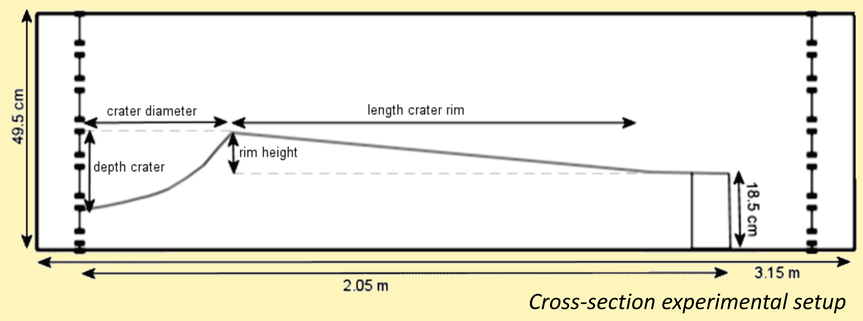
Aram Chaos

Fan-like morphology in crater related to outflow channel.



Methods

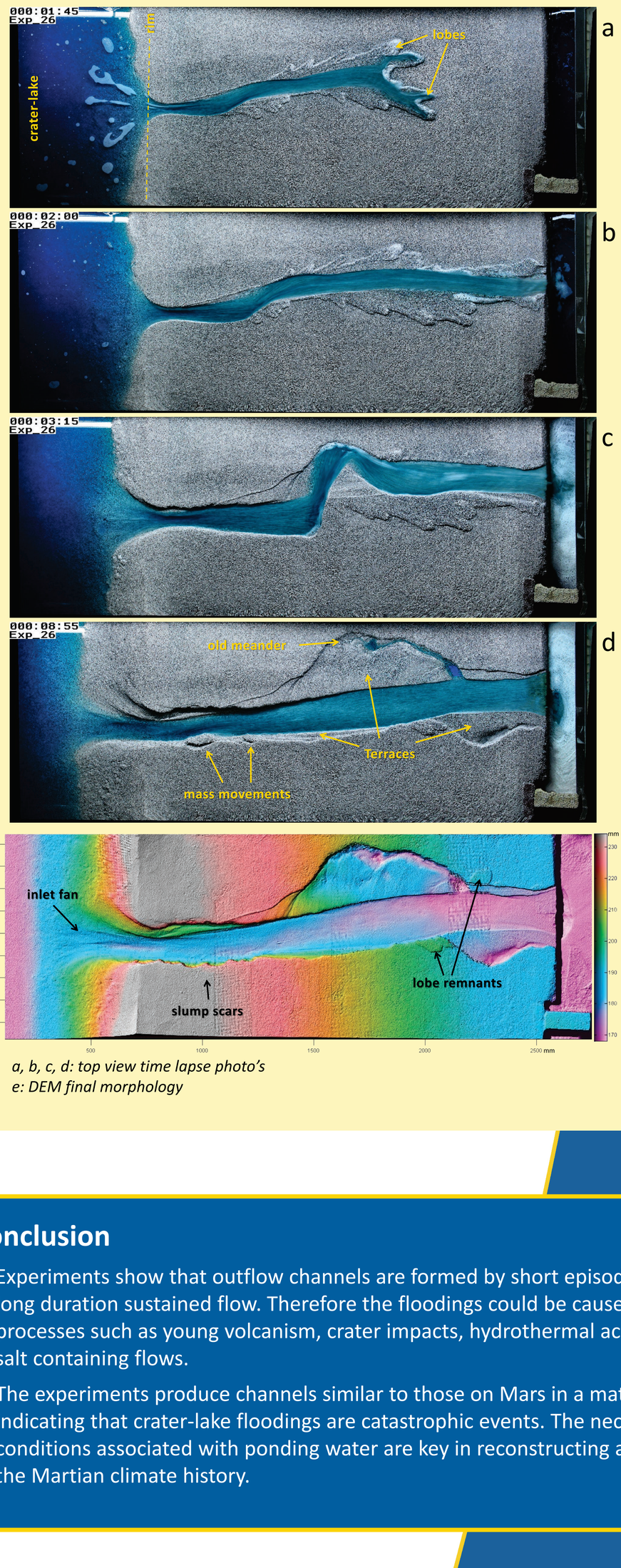
- 27 scale-experiments compared with literature and Mars imagery.
- 3m x 1m flume with light-weight sediment on a slope of 1cm/m.
- Crater geometry from literature.
- Data capture: time-lapse photography and vialux zSnapper 3D scanner.
- Data processing: ortho-photos, movies, DEMs, cross-sections and 3D images.



Cross-section experimental setup

Results

1. The lake level in the crater rises and ponds to maximum depth. Eventually the crater rim is overtopped and breached. (fig a)
2. Lobate patterns develop due to large sediment transport and infiltration (fig a)
3. Incision starts immediately and increases when the channel starts to develop further downhill. When the new gradient develops closer to an equilibrium, the incision slows down and widening starts. Developing U or box-shaped channels. (fig b, c)
4. Because of incision and lateral movement river terraces are formed. (fig d)
5. At certain points during the experiment the banks become too steep and sometimes overhanging which results in mass wasting processes. (fig d)
6. Erosional morphology develops in crater: inlet fan. (fig e)



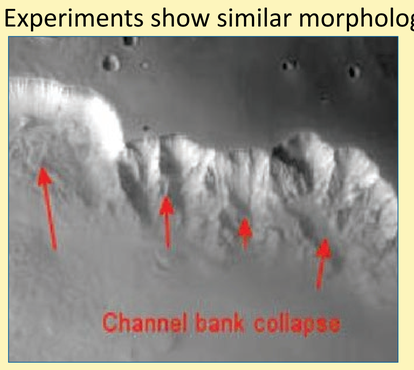
a, b, c, d: top view time lapse photo's
e: DEM final morphology

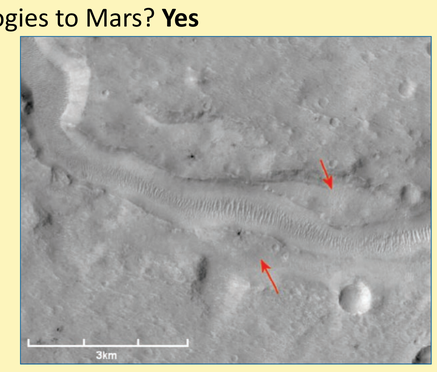
movie

publication

Discussion

Experiments show similar morphologies to Mars? **Yes**





Multiple events necessary for terrace development? **No**

Fan-like morphology Aram Chaos created by crater-lake flooding? **Yes**

Duration of the process is long/short? **Short**

Summerised

Multiple events necessary to develop outflow channels? **No**

Long term climate change necessary to develop outflow channels? **No**

Likely causes are local catastrophic processes

- Young volcanism
- Crater impacts
- Hydrothermal activity

Conclusion

- Experiments show that outflow channels are formed by short episodic flows rather than long duration sustained flow. Therefore the floodings could be caused by rapid local processes such as young volcanism, crater impacts, hydrothermal activity and acidic or salt containing flows.
- The experiments produce channels similar to those on Mars in a matter of minutes, indicating that crater-lake floodings are catastrophic events. The necessary climate conditions associated with ponding water are key in reconstructing and understanding the Martian climate history.

Acknowledgments

- Technical support at the physical geography lab; H. Markies, M. van Maarseveen, C. Roosendaal

References

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